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Report

Title: AI-Driven Flood Risk Forecasting and Preparedness to Minimize Losses.

Introduction:

Floods during intense rainfall in regions like Himachal Pradesh and Uttarakhand have become alarmingly frequent, leading to severe loss of life and infrastructure. Relying solely on weather forecasts often falls short in predicting the real-time impact of such events, especially in vulnerable terrains. The growing unpredictability of climate patterns demands smarter, localized solutions. Advancements in Artificial Intelligence and Machine Learning offer powerful tools to monitor, predict, and respond to flood risks more accurately. By analyzing features like rainfall, temperature, glacier melt, and river discharge patterns, AI models can issue early warnings. This project aims to create an interactive system that not only predicts risk but also educates and alerts concerned citizens in real time. Empowering communities with timely insights can be the key to preventing disasters before they strike.

Problem Statement:

The primary challenge addressed by this project is the is to mitigate the gap by integrating multiple parameters into 1 predictive and responsive system. Current flood prediction systems rely heavily on generalized weather forecasts, which lack real-time local precision and multiple like glacier melt, water run off make the task more complex and less reliable There is a need of an AI powered approach to provide timely, location specific flood risk assessment and alerts.

Objective:

The objective of this project is to develop, evaluate a Machine Learning model that not only predicts the rain, glacier melts, track the river water run off /discharge but also to educate and inform the alert situation to concerned areas and people for early evacuations or precautions.

Why this problem:

This recurring issue causes massive destruction to life, livelihoods, and critical infrastructure every year. Despite technological advances, vulnerable regions remain unprepared for sudden flood events. Addressing this aligns with multiple Sustainable Development Goals. By solving this, we can save lives, reduce economic loss, and enhance early warning systems for disaster preparedness.

Solution:

Overview: The solution involves developing a predictive model using a Linear Regression algorithm enhanced with lag and rolling statistical features. This model will leverage historical hydrological data, real-time measurements, and weather forecast information (rainfall and temperature) to predict river discharge levels in Himachal Pradesh. By integrating this model into a web-based application, we aim to provide an early warning system that classifies flood risk levels (Safe, Alert, Evacuate) and sends timely notifications to disaster management teams, evacuation units, and tourist agencies. This approach offers a proactive, data-driven, and cost-effective method to reduce the impact of floods and landslides in vulnerable regions.

Features:

1. **Cost-Effective & Proactive** – Enables preventive action before disaster strikes.
2. **Early Warning Alerts** – Sends notifications via email or messaging APIs to disaster management, evacuation teams, and tourist agencies.
3. **Automated Alarms** – Triggers visual warnings when predicted levels cross danger thresholds.
4. **Weather API Integration** – Fetches forecasted rainfall and temperature for improved prediction accuracy.
5. **Flood Risk Classification** – Automatically labels conditions as *Safe*, *Alert*, or *Evacuate*.

6. **Scalable & Customizable** – Can adapt to other river basins or regions with minimal retraining.
7. **Multiple Data Inputs** – Uses historical hydrological data, real-time river measurements, and weather forecast data.
8. **Continuous improvement-C**ontinuously learns and improves with new data and feedback, ensuring relevance and accuracy.

Technical Implementation:

Data Collection and Preprocessing: Gather comprehensive historical and real-time datasets, including river flow, rainfall, temperature, glacier melt, and weather forecasts. Handle missing values and preprocess the data for model training.

Feature Selection and Engineering: Identify key hydrological and meteorological features such as lag values, rolling averages, and forecast-based variables to improve model accuracy.

Model Development: Train a Linear Regression model incorporating both historical and forecast data, optimizing parameters for better prediction accuracy and stability.

Model Evaluation: Assess the model using metrics such as R^2, Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE) to ensure reliability.

Implementation and Validation: Develop a Streamlit-based interactive web application for real-time monitoring and forecasting and validate the model with independent data to ensure generalizability across varying weather conditions.

Conclusion: The Himachal Pradesh Flood Prediction System integrates historical and forecast data to provide accurate river discharge predictions. By leveraging Machine Learning models and real-time weather inputs, it offers early warnings for potential flood risks. This solution aims to enhance disaster preparedness, protect lives, and support decision-making for authorities and communities in vulnerable regions.